Dry Lab Overview:

Let DNA tell the Story

Expectations targeted:

Relating Science to Technology, Society and the Environment

B1.2 Evaluate, on the basis of research, some advances in cellular biology and related technological applications (e.g., new treatments for cancer, HIV/AIDS, and hepatitis C; radioisotopic labelling to study the function of internal organs; fluorescence to study genetic material within cells; ***forensic biological techniques to aid in crime resolution***).

Expectations overlap with Molecular Genetics Unit:

Developing Skills of Investigation and Communication

D2.2 Analyse a simulated strand of DNA to determine the genetic code and base pairing of DNA (e.g., determine base sequences of DNA for a protein; analyse base sequences in DNA to recognize an anomaly).

Understanding Basic Concepts

D3.2 Compare the structures and functions of RNA and DNA, and explain their roles in the process of protein synthesis.

Reference:

The general idea for the lab came from https://bsp.med.harvard.edu/?q=node/92. The original sequences were modified to highlight appropriate Start and Stop Codons, a paper gel was prepared based to allow easy resolution for the results of the digestion, and the second part of the lab was adapted based on the sequences and the resultant mRNA and peptide sequences.

Notes:

The intention of this lab is to place the in-class learning into an exciting and more approachable context, aligning it with what the students have come to expect from forensic drama on TV. The activity can also be placed in the context of research scientists examining evolution by observing gene conservation across species. The activity provides a hands-on opportunity for students to understand the process of DNA Fingerprinting, by producing and comparing two DNA fingerprints from two made-up DNA strands belonging to human and chimp.

The second part of the package provides an opportunity for students to transcribe DNA into mRNA and have the latter translated into a peptide sequence, to allow further comparison across species. This also presents an opportunity to stress the importance of the direction in which the template strand is read in each case, and the importance of start and stop codons in affecting the resultant amino acid sequence.

The original intention of the activity was to be used as a tool to update and cement current learning, and gauge student understanding of the material. The lab if marked would've been marked merely for completion, and otherwise be used as a diagnostic tool. However the activity does lend itself nicely to have a complete lab report

submission required where students start with either of two hypothesis, the first examining the similarities in DNA fingerprints between the human and chimp, or the second examining the similarities in the resultant amino acid sequences corresponding with each of the species. The students would then have an opportunity to highlight the procedure they followed to obtain their results (and if appropriate allude to actual lab procedure and equipment that would be used as highlighted in their texts and prior learning), and have an opportunity to present and discuss their findings.

When this resource was originally presented there was a suggestion to colour code the DNA templates, by highlighting codon groups, to make it easier for the students to recognize and distinguish. While this is definitely a possibility, it may create confusion by highlighting one possible reading frame over the other possible reading frames. However, having the students colour code each codon group after they have determined the correct reading frame in the second part is definitely a good idea.

Relevant Answers:

Human Digestion:

A T C C G G A T T C| T T A T A C C A A A G T T C A C |T T T G A C A T A C A T A T C A T A T C |T T C C G A C

Chimp Digestion

A T C C C| T T A T G T T A T A C C A T A G T C| T T C |T T T G A C A T A C A T A G G A T A T G T T C A C| T T

Human:

DNA: ATC CGG ATT CTT ATA CCA AAG TTC ACT TTG ACA TAC ATA TCA TAT CTT CCG AC
mRNA: UAG GCC UAA GAA UAU GGU UUC AAG UGA AAC UGU AUG UAU AGU AUA GAA GGC UG

Amino Acid: R P K N Met V S S E T V C I V Stop K A

Chimp:

DNA: ATC CCT TAT GTT ATA CCA TAG TCT TCT TTG ACA TAC ATA GGA TAT GTT CAC TT
mRNA: UAG GGA AUA CAA UAU GGU AUC AGA AGA AAC UGU AUG UAU CCU AUA CAA GUG AA

Amino Acid: R E Y N Met V S E E T V C I L Y K Stop